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RESEARCH REPORT

Postharvest Technology

Effect of cultivar and growing medium on the fruit quality attributes and antioxidant properties of tomato (*Solanum lycopersicum* L.)

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Abstract
The objective of this research was to identify the growing medium that yielded the highest nutritional quality and longest marketable shelf life in tomato fruits. 'TY Megaton' and 'Yureka' cultivars were grown on soil and coir pith in the same climate-controlled glasshouse using a standard nutrient solution and the recommended cultivation practices. Fruits were harvested at the pink stage of ripening and stored at 12 °C in 85 ± 5% relative humidity for 20 days. The fruits of both cultivars grown on either growing medium were of acceptable quality for sale after 3 weeks of storage. The contents of the most important secondary metabolites of tomato responsible for providing their antioxidant activity (ascorbic acid, lycopene, and polyphenols) were not significantly affected by the choice of growing medium; however, significant differences were observed between the cultivars throughout the storage period. The results of this study demonstrated that the choice of cultivar is more important for fruit quality than the growing medium. The lycopene content and antioxidant activity of the fruits suggest that it is possible to achieve optimum nutrition from the pink-stage fruit of both cultivars after 12 days of storage, irrespective of the growing medium used.

Keywords Antioxidant activity · Ascorbic acid · Coir pith · Growing media · Lycopene · Phenolics

1 Introduction

Tomato (*Solanum lycopersicum* L.) is a fruit crop that belongs to the Solanaceae family. It is believed to have originated from the Andean region of South America, and its increasing popularity over the last 50 years has led to the large-scale expansion of its cultivation (Preedy and Watson 2008). Tomato is an economically important crop, with a worldwide production of 170.75 million tons valued at $92.49 billion. China leads the global tomato cultivation, producing about 52.59 million tons annually, followed by India, which produces 18.73 million tons (FAOSTAT 2014). According to FAOSTAT (2014), tomato production in the Republic of Korea was 499,960 tons in 2014, which was valued at $743.57 million.

One of the key factors regulating plant growth, yield, fruit quality, and shelf life is the growing medium used for cultivation (Kowalczyk and Gajc-Wolska 2011). Growing media are used to provide aeration and water to the roots, enabling maximum growth and physically supporting the plant. Growing media should have large particles with adequate pore spaces between them (Bilderback et al. 2005). Many growers prefer to use growing media rather than soil because of problems with soil-borne pathogens and environmental regulations against groundwater pollution with nitrate and pesticides (Ghehsareh et al. 2011); however, limitations such as material disposal and rising costs can inhibit the development of soilless culture systems. One solution to these problems is the use of locally available substrate materials, which are less costly than imported materials, but which provide adequate physical and chemical properties (Tzortzakis and Economakis 2008).

The functional quality and constituent antioxidant compounds of tomatoes differ between genotypes and are significantly affected by environmental factors and agronomic

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practices (Dumas et al. 2003; Park et al. 2017). Tzortzakis and Economakis (2008) reported that adding shredded maize stems to a perlite and pumice growing medium led to higher yields and better fruit quality in tomato cultivation, and that fruit weight, fruit firmness, total soluble solids, titratable acidity (TA), carotenoids, and ascorbic acid contents were also influenced by substrate. Kowalczyk and Gajc-Wolska (2011) reported on the suitability of coconut fiber, wood fiber, and rock wool on soilless tomato cultivation. Ghehsareh et al. (2011) investigated the suitability of coir pith and perlite for the cultivation of a variety of plants, especially vegetables; these authors found that, for tomato cultivation, coir pith and date palm peat media have similar properties and did not result in significant differences in the qualitative and quantitative indexes of the fruit.

The selection of growing media may impact the shelf life, postharvest physicochemical and physiological changes, and overall nutritional content of tomatoes; therefore, it is necessary to identify the growing medium that best enhances these factors to create a profitable enterprise for tomato growers and fulfill consumer demand. Farmers in the study area commonly use coir pith and soil as growing media for the cultivation of tomato fruit. Coir pith is an agricultural byproduct resulting from the extraction of fiber from coconut husks, and it is considered a good media component with acceptable pH, electrical conductivity, and other chemical attributes (Abad et al. 2002). Luitel et al. (2012) reported that tomato plants grown in coir pith substrates produced higher fruit weights and marketable yields per plant, and they suggested it should be considered as a potential replacement for rock wool as a growing substrate in glasshouse tomato production in the Republic of Korea. As the growing medium is known to influence the quality of tomato fruit, the present study was carried out to determine whether soil or coir pith was a better substrate for enhancing the nutritional quality and shelf life of the 'TY Megaton' and 'Yureka' tomato cultivars.

2 Materials and methods

2.1 Tomato samples and storage conditions

Common locally grown tomato (*Solanum lycopersicum* L.) cultivars, 'TY Megaton' and 'Yureka', were grown on either soil or coir pith media in the same climate-controlled glasshouse in Gangwon province, Republic of Korea, in spring 2016, using a standard nutrient solution and standard cultivation practices. Fruits of uniform size that were free from physical defects were harvested at the pink stage of ripening, and a further careful selection of fruits was made in the laboratory using a color chart (USDA 1991), to ensure the uniform maturity of the sample fruits. The fruits were washed, wiped, and air-dried for 4 h before being placed in a commercial plastic box for the sale of tomatoes and stored in an optimum storage condition [12 °C and 85 ± 5% relative humidity (RH)] (Roberts et al. 2002; Sargent et al. 2005), with regular inspection for up to 20 days. Data were collected at 4-day intervals for all parameters.

2.2 Physicochemical changes

2.2.1 Fresh weight loss and firmness

Tomatoes were weighed prior to storage and at the end of the storage period. The post-storage weight was subtracted from the pre-storage weight, and the decrease in fresh weight was presented as a percentage (%) of the initial weight.

Tomato fruit firmness was measured by exerting a maximum force of 10 kg on the fruit using a Sun Rheo Meter Compac-100II (Sun Scientific Co. Ltd., USA) fitted to a 3-mm diameter stainless steel probe with a flat end. Measurements were taken at the equator of the fruit.

2.2.2 Respiration rate and ethylene production rate

The respiration rate of the tomato fruit was measured as a function of CO_2 concentration using the closed system method (Neelam et al. 2003). Tomato fruit samples were placed in an air tight 4-L container and the CO_2 concentration was analyzed before and after a 3-h incubation using a gas analyzer (CheckMate 9900; PBI-Dansensor, Denmark); the result was expressed as mg CO_2 kg^{-1} h^{-1}. A 1-mL gas sample was taken from the headspace of each container using an air-tight syringe and injected into a gas chromatograph to measure ethylene production. The gas chromatograph (Shimadzu Corporation, Japan) was equipped with a BP 20 wax column (30 m × 0.25 mm × 0.25 μm; SGE Analytical Science, Australia) and a flame ionization detector. The detector and injector were operated at 127 °C, the oven temperature was set at 50 °C, and the flow rate of the carrier gas (N_2) was 0.67 mL s^{-1}. The result was expressed as μL C_2H_4 kg^{-1} h^{-1}.

2.2.3 Soluble solids content, titratable acids, and pH

The soluble solids content (SSC) was determined for five sample fruits at 20 °C, using an Atago DR-A1 digital refractometer (Atago Co. Ltd., Japan), and was expressed as a percentage of sugar in tomato juice.

TAs were quantified by titrating diluted tomato juice (1:19 juice:distilled water) with 0.1 M NaOH up to pH 8.1 using a DL22 Food and Beverage Analyzer (Mettler Toledo Ltd., Switzerland). The result was expressed in mg of citric acid per 100 g of fresh tomato weight.

An InLab 413 pH meter (Mettler Toledo Ltd.) was used to measure pH.

2.2.4 Color changes

Hunter a* (redness), b* (yellowness), and L* (brightness) values (McGuire 1992) were determined using a CR-400 chroma meter (Minolta, Japan). Color variables were measured three times from the sides of three tomatoes (close to the equatorial section), and the average value was determined.

2.3 Antioxidant properties

2.3.1 Lycopene content

The lycopene contents of triplicate tomato samples were determined according to the method of Fish et al. (2002), with some modifications. Homogenized tomato samples (0.5 g of each) were placed into vials, to which 5 mL 0.05% (*w*/*v*) butylated hydroxyl toluene in acetone, 5 mL 95% (*v*/*v*) ethanol, and 10.0 mL hexane was added. The vials were then centrifuged at 15,000 rpm for 15 min, after which 3 mL deionized water was added to each vial, and the samples were shaken for 5 min. The vials were then left at room temperature for another 5 min without agitation to allow for phase separation. The absorbance of 503-nm light wavelengths by the hexane (upper) layer was measured using a spectrophotometer (Thermo Fisher Scientific, USA) against a hexane solvent blank. The lycopene content of the samples was expressed as mg kg^{-1} fresh weight.

2.3.2 Ascorbic acid

Vitamin C (ascorbic acid) was analyzed using reversed-phase liquid chromatography with UV detection, according to the method described by Kim et al. (2011) and Taye et al. (2017). Briefly, a 1-g sample was mixed with 10 mL 5% metaphosphoric acid and homogenized for 1 min. After centrifuging the mixture at 20,000 rpm for 10 min, the liquid layer of the extract was membrane-filtered (0.22 µm) and analyzed using a ZORBAX Eclipse XDB-C18 column (4.6 mm × 250 mm, 5 µm; Agilent Technologies, USA). The samples were detected at 265 nm using a UV-2075 detector (JASCO, Japan), with a 20-µL injection of a 1:9 solution of MeOH:0.1 M KH_2PO_4 at 1 mL min^{-1} as the mobile phase.

2.3.3 Total phenolics

The total phenolics content was quantified using the method described by Tilahun et al. (2017). Briefly, 2 g of each tomato sample (in duplicate) was extracted with 20 mL 0.05% (*v*/*v*) aqueous HCl/methanol (10:90, *v*/*v*) using a homogenizer (IKA Korea. Ltd., Republic of Korea) at speed 5 for 1 min, after which the homogenate was membrane-filtered (0.45 µm). The sample extract (0.2 mL) was mixed with 2.6 mL deionized water, 2 mL 7% (*w*/*v*) Na_2CO_3, and 0.2 mL Folin–Ciocalteu's phenol reagent. After incubating at room temperature for 90 min, a spectrophotometer (Thermo Fisher Scientific) was used to measure the absorbance of the reaction mixture at 750 nm against a blank sample containing the solution mixture without the sample extract. The total phenolics content was expressed in mg of gallic acid equivalents (GAE) per kg of sample fresh weight.

2.3.4 Antioxidant activity

Using duplicates of the extracts used to quantify the total phenolics contents, antioxidant activity was measured in a spectrophotometric assay using the 2,2-diphenyl-1-picrylhydrazyl (DPPH) method reported by Pataro et al. (2015), with some modifications. First, cuvettes (Kartell, Italy) containing 3.9 mL DPPH dissolved in methanol (0.1 mM) were prepared, and their absorbance at 515 nm was read immediately ($t_0 = 0$ min). Methanol was used as the blank. Subsequently, 800 µL of each tomato extract was mixed with 3.2 mL methanol-DPPH and kept in the dark for 30 min (t_{30}) at room temperature before their absorbances were measured. The percentage of DPPH inhibition was calculated as follows:

$$\%\text{reduced DPPH} = [(\text{absorbance } t_0 - \text{absorbance } t_{30})/\text{absorbance } t_0] \times 100.$$

2.4 Statistical analysis

The experiment was conducted in a completely randomized design. Nine replications were performed for the color analysis; five replications were used for the measurements of weight loss, firmness, SSC, TA, and pH; and three repeats were performed for all other parameters. The data were analyzed with an analysis of variance (ANOVA) at $p < 0.05$ using SAS statistical software (SAS/STAT® 9.1; SAS Institute Inc., USA). When significant differences were detected, a Duncan's multiple range test was performed to determine which particular values were significantly different ($p < 0.05$).

3 Results and discussion

3.1 Physicochemical changes

3.1.1 Firmness and weight loss

The firmness of the fruit of both cultivars reduced significantly ($p < 0.05$) during the 20-day storage period,

irrespective of the growing medium used (Fig. 1), but 'Yureka' was always firmer than 'TY Megaton' ($p < 0.05$). The highest fruit firmness, 15.49 N, was recorded in 'Yureka' tomatoes grown on soil immediately after harvest, which had decreased by 47% to 8.21 N after 20 days of storage. The lowest firmness was recorded in 'TY Megaton' tomatoes grown on coir pith; immediately after harvest the firmness of these fruits was 9.19 N, which reduced by 33.84% to 6.08 N after 20 days of storage (Fig. 1). Batu (2004) suggested two possible minimum firmness limits for tomato fruits at the point of sale (1.45 N) and at home (1.28 N), determined by applying 50 N force using a 6-mm diameter stainless steel probe with a flat end. The firmness of both cultivars was above the minimum limit for marketing even after 3 weeks of storage at 12 °C and 85 ± 5% RH, regardless of the growing medium used.

Significant ($p < 0.05$) interactions between the varieties and the growing media in terms of an effect on weight loss were only observed on the 4th and 16th days of storage. The percentage of weight loss increased as the storage period progressed in both cultivars, irrespective of the growing medium used (Fig. 1). Non-significant ($p > 0.05$) differences in weight loss, ranging from 4.17 to 4.42%, were observed at the end of the 20-day storage period (Fig. 1). Getinet et al. (2008) suggested that a threshold of a 10% physiological loss in weight should be considered an index of the end of the shelf life for tomatoes, while Nunes (2008) considered the maximum acceptable weight loss of a tomato to be 6–7% before it becomes unsaleable. In this study, the weight loss values of both cultivars grown on soil and coir pith media were found to be lower than the thresholds suggested by Nunes (2008) and Getinet et al. (2008); their shelf lives may have been extended by their storage at the optimum temperature (12 °C) with proper RH management (85 ± 5%). Sargent et al. (2005) suggested that maintaining RH at 85–95% minimizes tomato fruit water loss by reducing evaporation through the stem scar, preventing the shrivel symptoms that may become apparent after a loss of 3% of the fruit's initial weight. In the present study, weight loss exceeded 3% after 12 days of storage for both cultivars, grown on both coir pith and soil, but no symptoms of shriveling were observed during the 20-day storage period (Fig. 1).

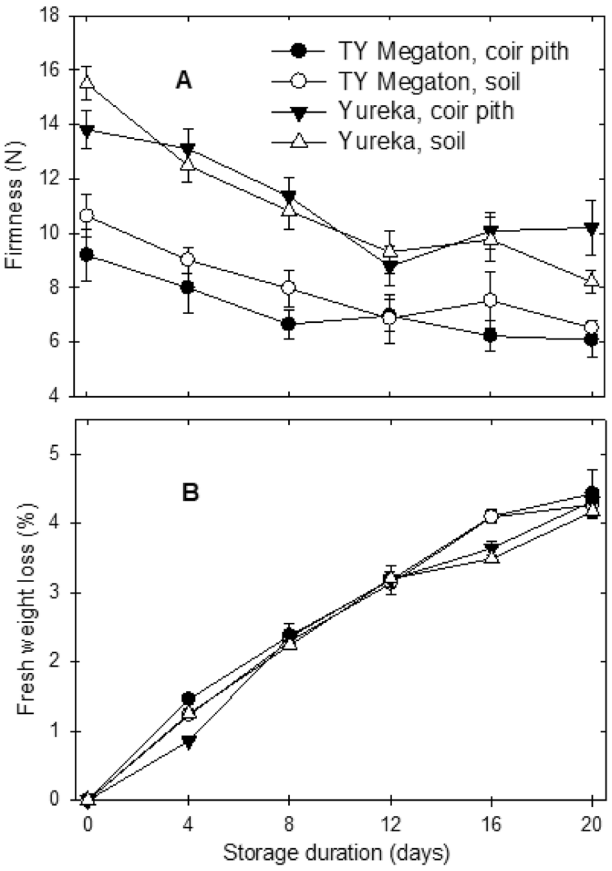

Fig. 1 The interaction effect of cultivar and growing medium on the firmness (**a**) and weight loss (**b**) of tomato fruits during 20 days of storage at 12 °C and 85 ± 5% relative humidity. Each data point is the mean of five sample replicates ± standard error

3.1.2 Ethylene production rate and respiration rate

Significant ($p < 0.05$) interactions between the varieties and the growing media in terms of an effect on ethylene production rate were observed on days 0, 4, and 20 of the storage period. The ethylene production rate of both cultivars followed the same trend, increasing up to day 4 then significantly decreasing ($p < 0.05$) after the 4th day of storage, irrespective of the growing medium (Fig. 2). Ethylene production peaked on the 4th day of storage for all tomatoes, reaching 4.06 μL C_2H_4 kg^{-1} h^{-1} for 'TY Megaton' grown on coir pith, 4.07 μL C_2H_4 kg^{-1} h^{-1} for 'TY Megaton' grown on soil, 3.59 μL C_2H_4 kg^{-1} h^{-1} for 'Yureka' grown on coir pith, and 3.46 μL C_2H_4 kg^{-1} h^{-1} for 'Yureka' grown soil. This result was similar to the findings of Lee et al. (2007), who reported a peak in ethylene production at the earlier stages of ripening in Roma-type tomatoes at 20 °C.

Significant ($p < 0.05$) interactions between the varieties and the growing media were also observed in terms of respiration rate throughout the storage period. The highest respiration rates of both cultivars were observed on day 0; 31.05 and 27.49 mg kg^{-1} h^{-1} for coir pith-grown and soil-grown 'TY Megaton', respectively and 26.38 and 24.57 mg kg^{-1} h^{-1} for coir pith-grown and soil-grown 'Yureka', respectively (Fig. 2). Lee et al. (2007) reported a similar trend, and found that the highest respiration rate for Roma-type tomatoes was 33 mg kg^{-1} h^{-1}.

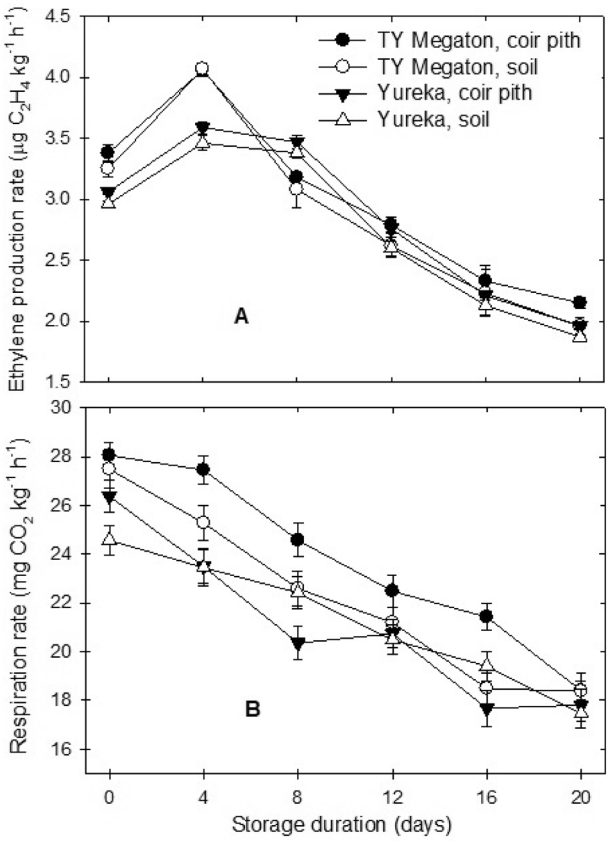

Fig. 2 The interaction effect of cultivar and growing medium on the respiration (**a**) and ethylene production (**b**) rates of tomato fruits during 20 days of storage at 12 °C and 85 ± 5% relative humidity. Each data point is the mean of five sample replicates ± standard error

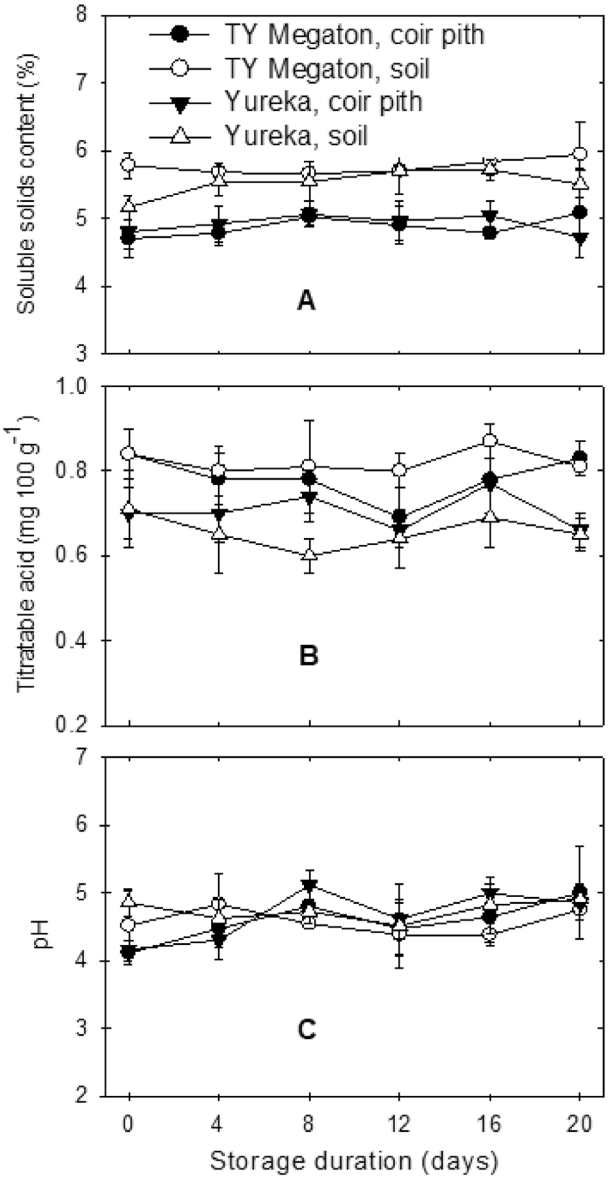

Fig. 3 The interaction effect of cultivar and growing medium on the soluble solids content (SSC) (**a**), titratable acid (TA) (**b**), and pH (**c**) of tomato fruits during 20 days of storage at 12 °C and 85 ± 5% relative humidity. Each data point is the mean of five sample replicates ± standard error

3.1.3 SSC, TA, and pH

There was a significant ($p < 0.05$) interaction between the cultivars and the growing media on the biochemical characteristics of the tomatoes (Fig. 3). The SSC of both 'TY Megaton' and 'Yureka' fruits grown on soil remained higher than those grown on coir pith throughout the storage period. The maximum SSC was recorded on day 20 for soil-grown 'TY Megaton' (5.94%) and on day 16 for soil-grown 'Yureka' (5.72%); similarly, the maximum SSC occurred on day 20 for the coir pith-grown plants of both cultivars ('TY Megaton', 5.08%; 'Yureka', 5.04%). Suárez et al. (2008) determined the SSC, TA, and pH of five tomato cultivars, reporting significant differences between both the genotypes and the cultivation methods. In the present study, the TA was maintained throughout the storage period, with a slight decline as the storage period progressed in both cultivars grown on each growing medium, whereas pH showed a slight increasing trend (Fig. 3). de Jesús Dávila-Aviña et al. (2011) reported that most of the hydrogen ions in tomatoes are derived from organic acids, which normally decrease with ripening, consequently increasing the pH of the fruit. This reduction in acidity as the fruit matures might also be associated with the conversion of organic acids into sugars and their derivatives, or their utilization in respiration (Rai et al. 2012).

3.1.4 Color changes

Color, determined by skin and flesh pigmentation, is one of the most important quality factors that influence consumer purchasing decisions (Fraser et al. 1994; Brandt et al. 2006).

In the present study, a significant ($p < 0.05$) interaction was identified between the cultivars and the growing media in terms of the Hunter L* (brightness) and b* (yellowness) color values. Both cultivars showed a reducing trend in these values as the storage period progressed, irrespective of the growing medium used (Fig. 4). 'Yureka', grown on both growing media, exhibited higher Hunter b* values than 'TY Megaton' throughout the storage period. The Hunter a* values (redness) increased in the tomatoes during the storage period; the lowest (+ 2.07) and highest (+ 14.68) Hunter a* values were recorded from 'TY Megaton' at days 0 (coir pith) and 16 (soil) of storage, respectively. The lowest (+ 2.75) and highest (+ 13.71) Hunter a* values of 'Yureka' were recorded from tomatoes grown on soil after 0 and 20 days of storage. The trend of the Hunter a* values was similar to the trend observed for lycopene content in the present study, which was also reported by Arias et al. (2000) and Tilahun et al. (2017). Fraser et al. (1994) demonstrated that the red coloration in tomatoes is the result of the conversion of chloroplasts into chromoplasts, which involves chlorophyll degradation and the biosynthesis of lycopene and other carotenoids.

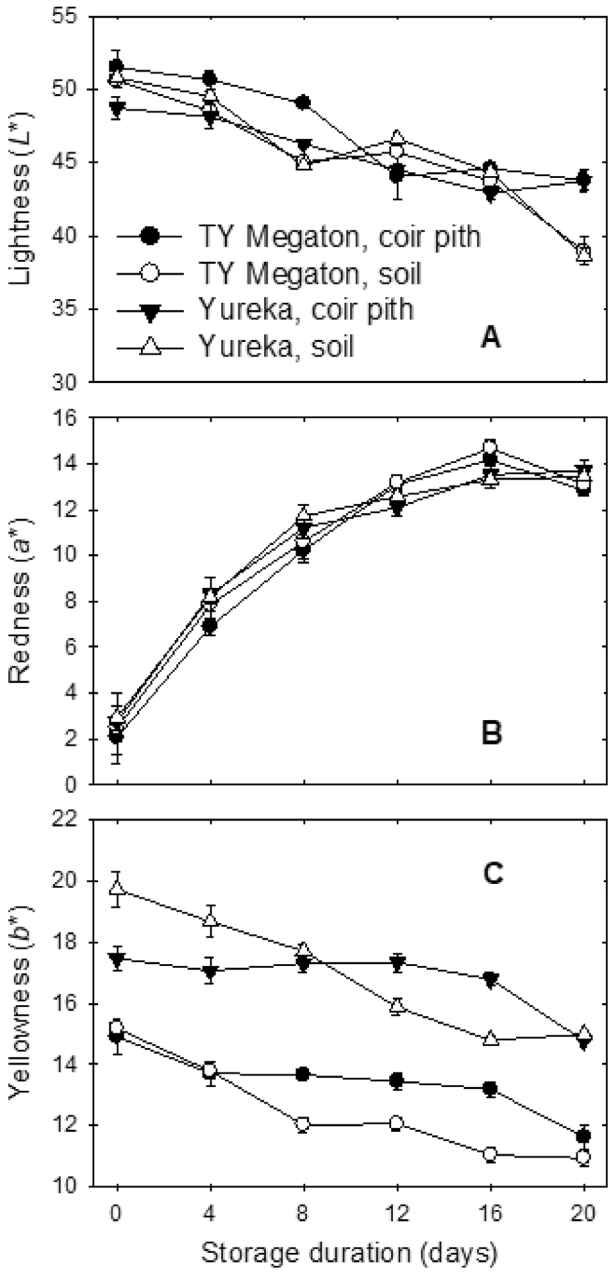

Fig. 4 The interaction effect of cultivar and growing medium on Hunter L* (**a**), a* (**b**) and b* (**c**) values of tomato fruits during 20 days of storage at 12 °C and 85 ± 5% relative humidity. Each data point is the mean of nine sample replicates ± standard error

3.2 Antioxidant properties

3.2.1 Lycopene

the results of the present study revealed a non-significant ($p > 0.05$) interaction between the cultivars and the growing media in terms of lycopene content, but there was a significant ($p < 0.05$) difference between the lycopene contents of the two cultivars after the 8th day of storage (Fig. 5). The lycopene contents peaked at 22.48 and 22.95 mg kg^{-1} for the coir pith- and soil-grown 'TY Megaton', respectively, on 16th day of storage. In contrast, the lycopene contents of 'Yureka' tomatoes reached their peaks of 23.18 mg kg^{-1} (coir pith-grown) and 23.68 mg kg^{-1} (soil-grown) on day 20. This variation in lycopene content between cultivars was also observed by George et al. (2004), who also found that lycopene content increased as the storage period progressed. As the fruit develops from the mature green stage to the red stage, the lycopene concentration increases significantly (Dumas et al. 2003; Brandt et al. 2006; Helyes et al. 2006). Lycopene begins to accumulate after the breaker stage until, at the ripe red stage, lycopene comprises 95% of all colored carotenoids in tomatoes (Dumas et al. 2003). Based on our results, the optimum lycopene content of 'TY Megaton' tomato fruits harvested at the pink stage can be achieved with storage at 12 °C for 12–16 days, irrespective of the growing medium. On the other hand, the optimum lycopene content of 'Yureka' tomatoes grown on either medium can be achieved by storing pink-stage fruits for 12–20 days.

3.2.2 Ascorbic acid content

No significant interactions were observed between the cultivars and the growing media for the ascorbic acid (vitamin C) content throughout the storage period, but a significant ($p < 0.05$) difference was found between the cultivars on 4th and 20th days of storage (Fig. 5). The ascorbic acid contents ranged from 20.92–30.44 to 21.44–29.07 mg 100 g^{-1} for 'TY Megaton' grown on coir pith and soil, respectively, and

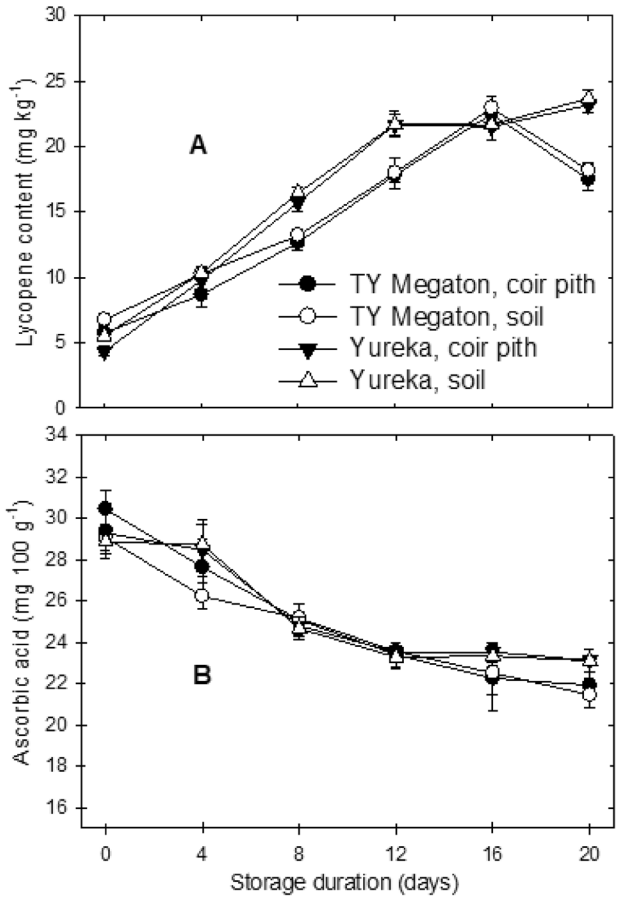

Fig. 5 The interaction effect of cultivar and growing medium on the lycopene (**a**) and ascorbic acid (**b**) contents of tomato fruits during 20 days of storage at 12 °C and 85 ± 5% relative humidity. Each data point is the mean of three sample replicates ± standard error

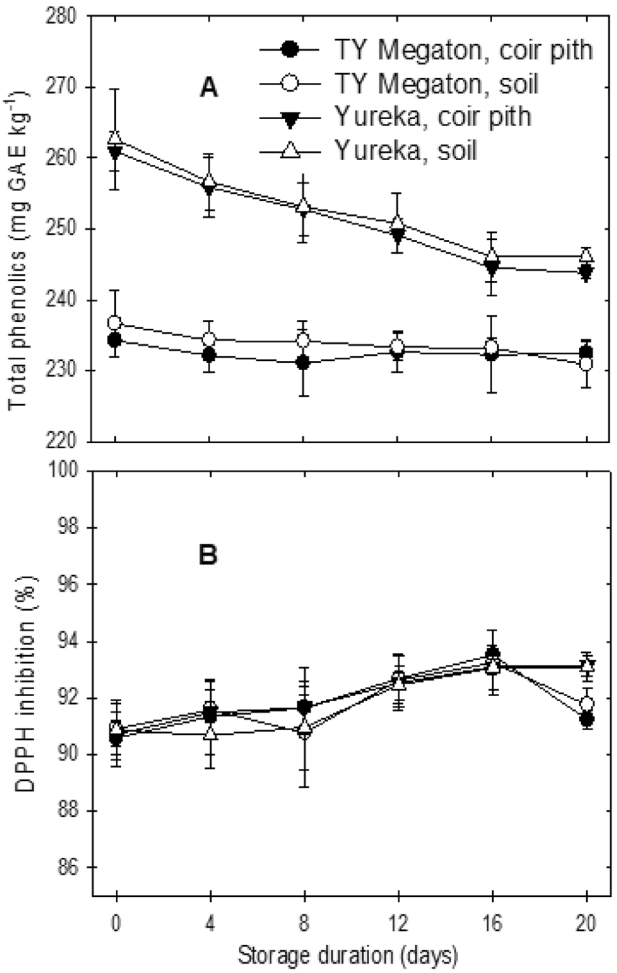

Fig. 6 The interaction effect of cultivar and growing medium on the total phenolics (**a**) and antioxidant activity (**b**) of tomato fruits during 20 days of storage at 12 °C and 85 ± 5% relative humidity. Each data point is the mean of three sample replicates ± standard error

were 23.11–29.28 and 23.10–28.86 mg 100 g^{-1} for 'Yureka' grown on coir pith and soil, respectively. These findings supported the work of Prema et al. (2011), who reported ascorbic acid contents ranging from 21.22 to 27.48 mg 100 g^{-1} in cherry tomato genotypes. In the present study, the ascorbic acid contents decreased gradually as storage progressed, with the lowest values recorded on 20th day of storage, irrespective of the variety or growing medium. Rai et al. (2012) reported a similar decrease for tomatoes stored under ambient conditions, while Tilahun et al. (2017) reported similar trends for 'TY Megaton' and 'Yureka' stored at 12 °C.

3.2.3 Total phenolics

There were no significant interactions between the cultivars and the growing media on the total phenolic contents of the tomatoes, but there was a significant ($p < 0.05$) difference between the cultivars throughout the storage period, irrespective of the growing medium used (Fig. 6). 'Yureka' exhibited higher total phenolic values throughout the storage period on both growing media, with maximum values of 262.67 and 260.95 mg GAE kg^{-1} recorded on day 0 for plants grown on soil and coir pith, respectively. The range of total phenolic contents (231.05–262.67 mg GAE kg^{-1}) found in both cultivars in the present study were similar to those reported by Park et al. (2016) and Tilahun et al. (2017); however, Helyes et al. (2006) reported higher polyphenol contents, ranging from 330 to 480 mg GAE kg^{-1} in 'Lamance F1' tomato fruits.

3.2.4 Antioxidant activity

There were no significant interactions between the cultivars and the growing media on the DPPH radical scavenging abilities of the tomato fruits, but a significant difference was observed between the cultivars on day 20 (Fig. 6). The highest DPPH radical scavenging rates for coir pith- and soil-grown 'TY Megaton' (93.51 and 93.24%, respectively) were

recorded on the 16th day of storage. In contrast, the highest DPPH radical scavenging rates for 'Yureka' (93.14% for coir pith-grown tomatoes and 93.09% for soil-grown tomatoes) were recorded on day 20. Similar trends were observed for DPPH radical scavenging and lycopene content. Rao and Rao (2007) reported that lycopene was a highly effective antioxidant, owing to its ability to act as a free radical scavenger, with the highest singlet oxygen quenching rate of all the carotenoids tested from biological systems. An increased consumption of tomatoes and tomato products has also been reported to be associated with a decreased risk of prostate cancer, which is thought to be related to the antioxidant properties of lycopene (Giovannucci et al. 2002; Etminan et al. 2004).

4 Conclusions

The results of this study revealed that 'TY Megaton' and 'Yureka' tomatoes grown on coir pith or soil remain suitable for sale after 3 weeks of storage at 12 °C with 85 ± 5% RH. The most important compounds for the secondary metabolism of the tomato and its antioxidant activity (ascorbic acid, lycopene, and polyphenols) were not significantly affected by the growing medium; however, significant differences were observed for these quality attributes between the two cultivars throughout the storage period. Provided that the recommended standard nutrient solution and cultural practices for tomato cultivation are followed throughout the growing period, the choice of cultivars, rather than the growing medium, should be given priority. Based on the lycopene content and the DPPH radical scavenging ability, the optimum nutritional content of pink-stage 'TY Megaton' fruit can be achieved with storage at 12 °C for 12–16 days, irrespective of the growing medium used. The optimum nutritional content of 'Yureka', grown on either medium, could be achieved by storing pink-stage fruits at 12 °C for 12–20 days.

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